The U.S. Navy Presents Research on a New Method for Reducing the Risk of DCS

A Pill to Prevent the Bends?

BY SUSAN R. KAYAR, PHD

The risk of decompression sickness increases sharply if you go deeper, stay longer or surface more rapidly than recommended by accepted dive plan guidelines. And even if you do obey all the rules, the risk of bending is never zero. So, wouldn't it be nice if there were some way to help increase your level of safety?

The pill to prevent the bends does not yet exist. But, the concept is real enough to have been demonstrated with research animals and to have received U.S. Patent Number 5,640,310.

During the Cold War with Russia, some people in the U.S. Navy decided that there was great potential for operations requiring ultra-deep diving, to depths of 1,000 to 2,000 feet of seawater. The Navy considered using hydrox, a mixture of hydrogen and oxygen, as the breathing gas for these dives. Its low density makes it easier for divers to breathe, especially while working, than other deep diving mixes, such as heliox.

Bacteria may be the answer to shorter decompression times.

Hydrox diving had already been considered for a number of years, but was relatively little used. The Navy quietly began funding research on the safety and usefulness of hydrox diving, including something called hydrogen biochemical decompression. A Navy biochemist, Dr. Lutz Kiesow, had the imagination to realize that while hydrogen is inert to the respiration of humans or any other animal, there are many bacteria that can metabolize hydrogen. If a hydrox diver could be given the biochemical machinery of these bacteria, some of the hydrogen load in the tissues of the diver could be reduced, thereby reducing the diver's risk of decompression sickness on surfacing. As is often the case with great thinkers, Dr. Kiesow was laughed at by other scientists when he first suggested hydrogen biochemical decompression.

Undeterred by the laughter, researchers at the Naval Medical Research Center spent several years on this project. With the collaboration of microbiologists at the New York State Department of Health and the University of Georgia, we generated results showing that hydrogen biochemical decompression really would work. Cultures of whole live bacteria, *Methanobrevibacter smithii*, were put into the large intestines of lab rats and pigs. When the animals were placed in a hyperbaric chamber pressurized with hydrox, the bacteria began to consume some of the hydrogen circulating throughout the animals, effectively turning the intestines into a chemical scrubber unit. The chemical pathway for this bacterial metabolism is ideal for our purpose: The hydrogen combines with carbon dioxide (which is plentiful in any animal) to produce water and methane. The water, a perfect non-toxic end product, simply gets absorbed into the body. The methane escapes harmlessly from the intestine along with other intestinal gases, giving us an excellent way to track the progress of the chemical scrubbing. When the animals were decompressed from their hydrox exposure, the incidence of decompression sickness was reduced to half of the incidence for untreated animals.

Did it make people stop laughing? *Au contraire*. To secure continued funding for this

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research to a point at which it would be feasible to consider it for human use, this project had to be sold to the Navy's funding sponsors at a variety of high-level meetings. Imagine large rooms filled with very serious people in black suits listening to other presentations on guns, ships, helicopters and the like. This research can be described, as above, in perfectly reasonable scientific language. Or not. Let's face it, I was trying to sell the Navy a way to reduce decompression sickness risk by describing research involving flatulence from rats and pigs. It does not take long for a quick-witted audience to go from serious nods and busy note-taking to chuckling, and from there to pointed questions and outright laughter. One of the questions was, "Does this mean that we can eliminate underwater propulsion vehicles for divers?" But, the funding continued.

The bacteria we are using are native to the intestines of humans and are well-known

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not to cause infections. There was never any sign in any of the animal research that these bacteria were irritating to the intestine or the animal in general. The extension of this work to humans is quite straightforward. The bacteria can be dried and packaged in capsules with coatings that will keep the capsules from breaking open in the stomach, where stomach acid would be deadly to the bacteria. This technology is already in use for such things as coatings on aspirin for people with weak stomachs. It takes approximately two weeks to decompress from a dive to 1,000 feet after remaining on the bottom for a minimum of 24 hours. With hydrogen biochemical decompression, we calculate that this decompression time can be safely cut at least in half.

What about nitrogen biochemical decompression, so that all air divers can benefit? The theory is exactly the same: Find a harmless species of bacteria native to the human intestine that metabolizes nitrogen, package it, swallow it, wait about 12 hours for transit to the large intestine, then go diving. Such bacteria exist. The end products of nitrogen metabolism, ammonia, nitrites and nitrates are rather nasty in large quantities. But these are all present in the intestines in small quantities normally, and the additional volumes generated on an air dive would not be problematic. The big stumbling block is the efficiency of nitrogen-metabolizing bacteria, or rather, the inefficiency. The biochemical processes involved in metabolizing nitrogen are many times slower than the processes for metabolizing hydrogen. At present, the volumes of bacteria required to scrub a useful amount of nitrogen in a reasonable number of minutes would be too large to fit in your intestine. So the pill against biochemical decompression from air dives, although feasible in concept, will have to wait for microbiologists to engineer a better bug. ▼

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